

## POWER PLANT CFM LEAP-1A PRESENTATION

### INTRODUCTION

The CFM LEAP-1A engine is an axial flow, dual-rotor, variable stator, high bypass ratio power plant. These engines power the A319, A320 and A321 aircraft of the Single Aisle (SA) New Engine Option (NEO) family. These engines reduce fuel consumption, air pollution and noise.

CFM International is a joint venture of GE and Safran Group's Snecma. CFM LEAP-1A engines are available in several thrust ratings from 23000 lbs (10400 kg) to 33000 lbs (14900 kg).

The basic A320 model equipped is the A320-251N (Weights in Pounds: Maximum Take Off Weight (MTOW) = 174165, Maximum Landing Weight (MLW) = 148591, Maximum Zero Fuel Weight (MZFW) = 141757).

For each model, the basic thrust ratings are referred with "1", reduced thrust ratings are referred with "2", increased thrust ratings are referred with "3".

| A/C  | A/C model | Rating    | Max Thrust | MTOW   | MLW    | MZFW   |
|------|-----------|-----------|------------|--------|--------|--------|
| A319 | A319-151N | LEAP-1A24 | 24.4 klbs  | 75,5 t | 63,9 t | 60,3 t |
|      | A319-152N | LEAP-1A23 | 22.9 klbs  |        |        |        |
|      | A319-153N | LEAP-1A26 | 26.6 klbs  |        |        |        |
| A320 | A320-251N | LEAP-1A26 | 26.6 klbs  | 79 t   | 67,4 t | 64,3 t |
|      | A320-252N | LEAP-1A24 | 24.4 klbs  |        |        |        |
|      | A320-253N | LEAP-1A29 | 29 klbs    |        |        |        |
| A321 | A321-251N | LEAP-1A32 | 32.1 klbs  | 93,5 t | 79,2 t | 75,6 t |
|      | A321-252N | LEAP-1A30 | 29.7 klbs  |        |        |        |
|      | A321-253N | LEAP-1A33 | 32.9 klbs  |        |        |        |

MTOW: Maximum Take Off Weight  
MLW: Maximum Landing Weight  
MZFW: Maximum Zero Fuel Weight



## INTRODUCTION

## POWER PLANT CFM LEAP-1A PRESENTATION

### INSTALLATION

The engine is attached to the pylon by forward and aft mounts to transmit the engine and thrust loads.

The pylon connects the engine to the wing structure.

The engine nacelle:

- Ensures smooth airflow both around and into the engine,
- Protects the engine and the engine accessories,
- Provides engine noise attenuation,
- Permits access to the engine & its components for servicing.

The Powerplant major components are:

- Air Intake (or inlet) Cowl,
- Fan Cowl Doors with 3 latches,
- Thrust Reverser Cowl Doors with 8 latches,
- Engine Build up,
- Exhaust Nozzle and Plug.

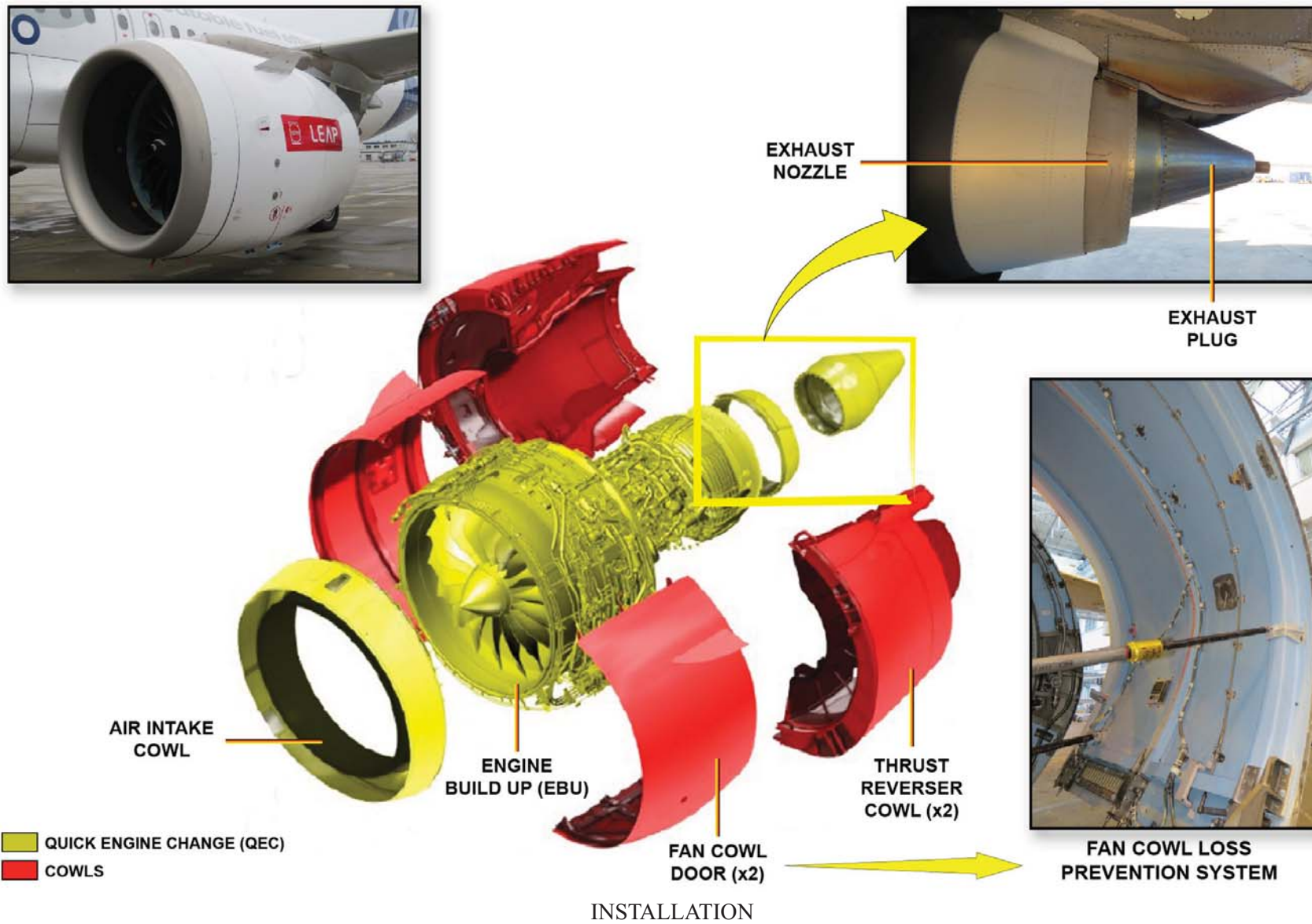
NOTE: A Fan Cowl loss prevention system is installed:

- Mechanically with a flag,
- Electrically monitored by proximity switches.



## INSTALLATION





THIS PAGE INTENTIONALLY LEFT BLANK

## POWER PLANT CFM LEAP-1A PRESENTATION

### ENGINE

#### LP SHAFT

The CFM LEAP-1A is a high bypass ratio (BPR 11:1) dual spool turbofan.

The Low Pressure system is a direct drive architecture including:

- 18 blades
- 3
- -D woven carbon fiber composite fan (and composite fan case).

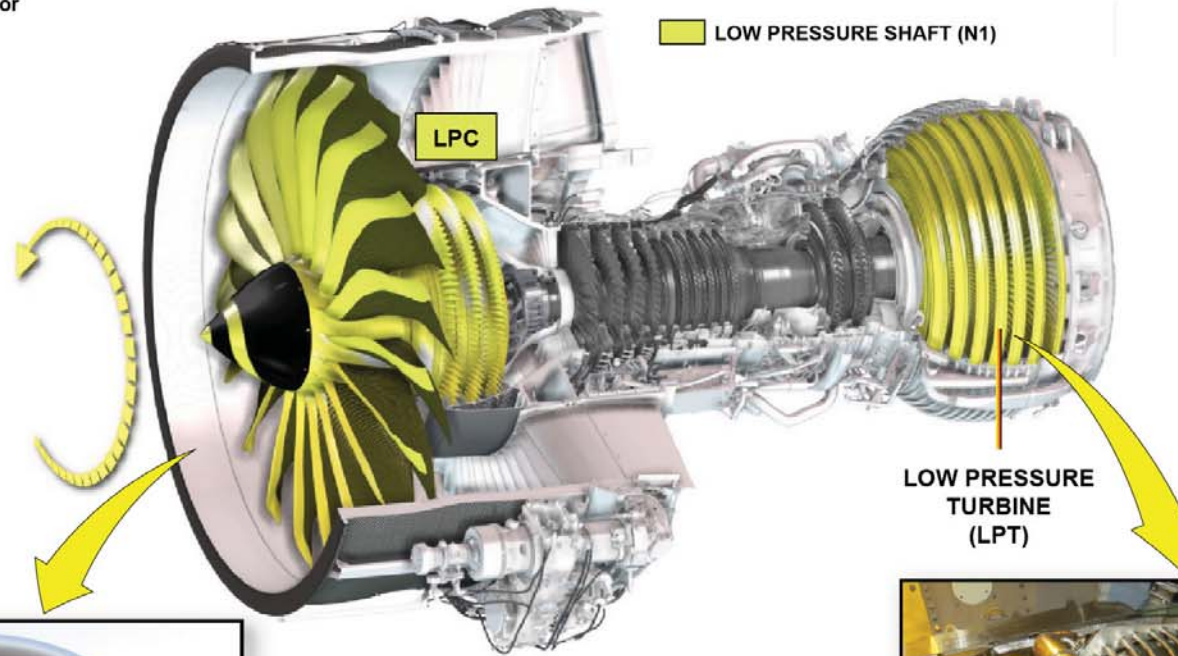
The fan supplies most of the engine thrust. The air produced by the fan is known as secondary or bypass airflow.

- A 3 stage booster supplies air to the engine core. This is primary airflow.

- 7 stage Low Pressure Turbine (LPT).

The speed of the LP rotor is indicated on the ECAM as N1.

LPC: Low Pressure Compressor



ENGINE - LP SHAFT



## POWER PLANT CFM LEAP-1A PRESENTATION

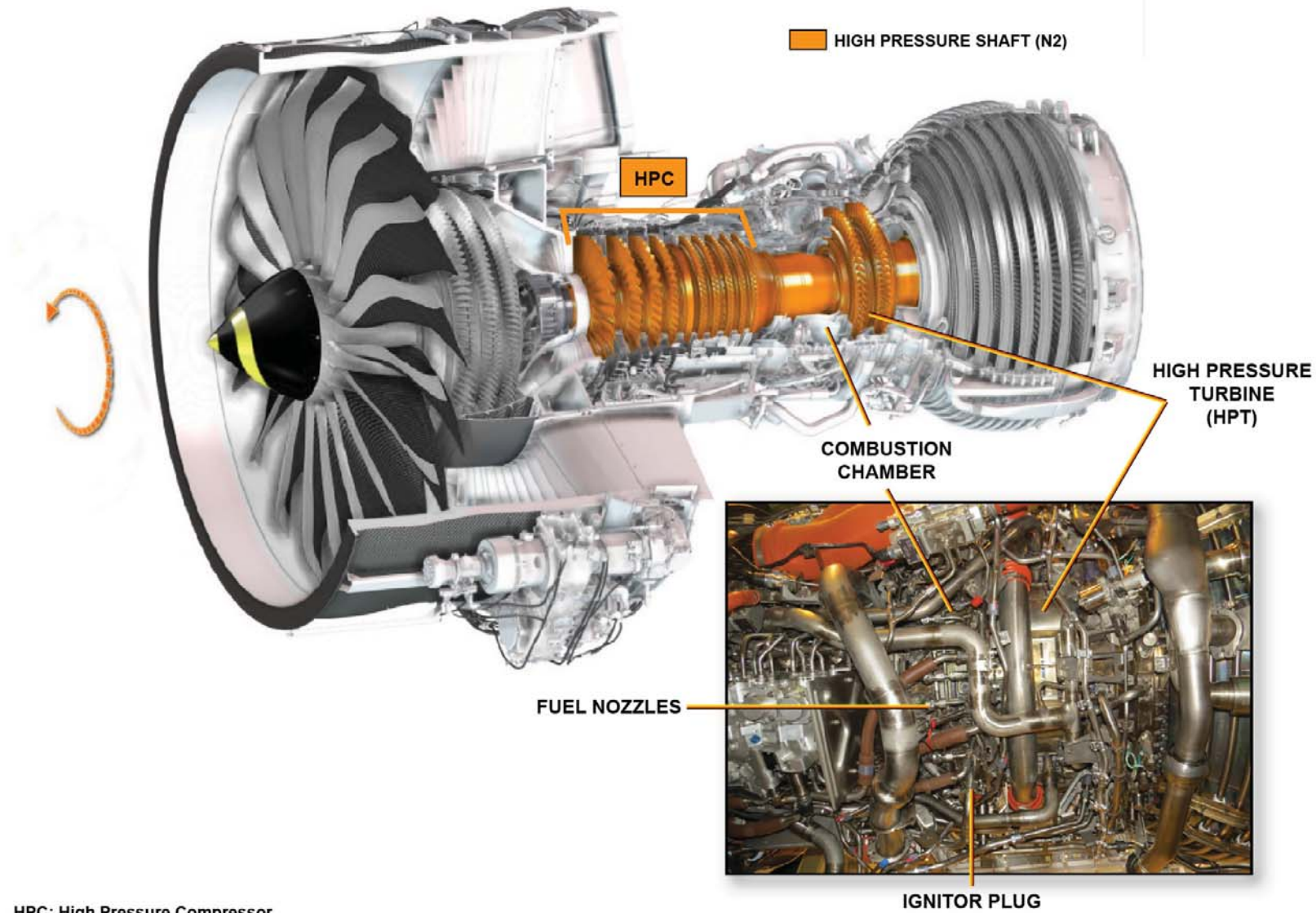
### **ENGINE (continued)**

#### **HP SHAFT AND COMBUSTION CHAMBER**

The High Pressure (HP) rotor is made up of 10 stages HP Compressor (HPC) driven by two stages HP Turbine (HPT). The speed of the HP rotor is indicated on the ECAM as N2.

The annular combustion chamber is installed between the HPC and HPT.

It has ports for 19 fuel nozzles and 2 igniter plugs.



## POWER PLANT CFM LEAP-1A PRESENTATION

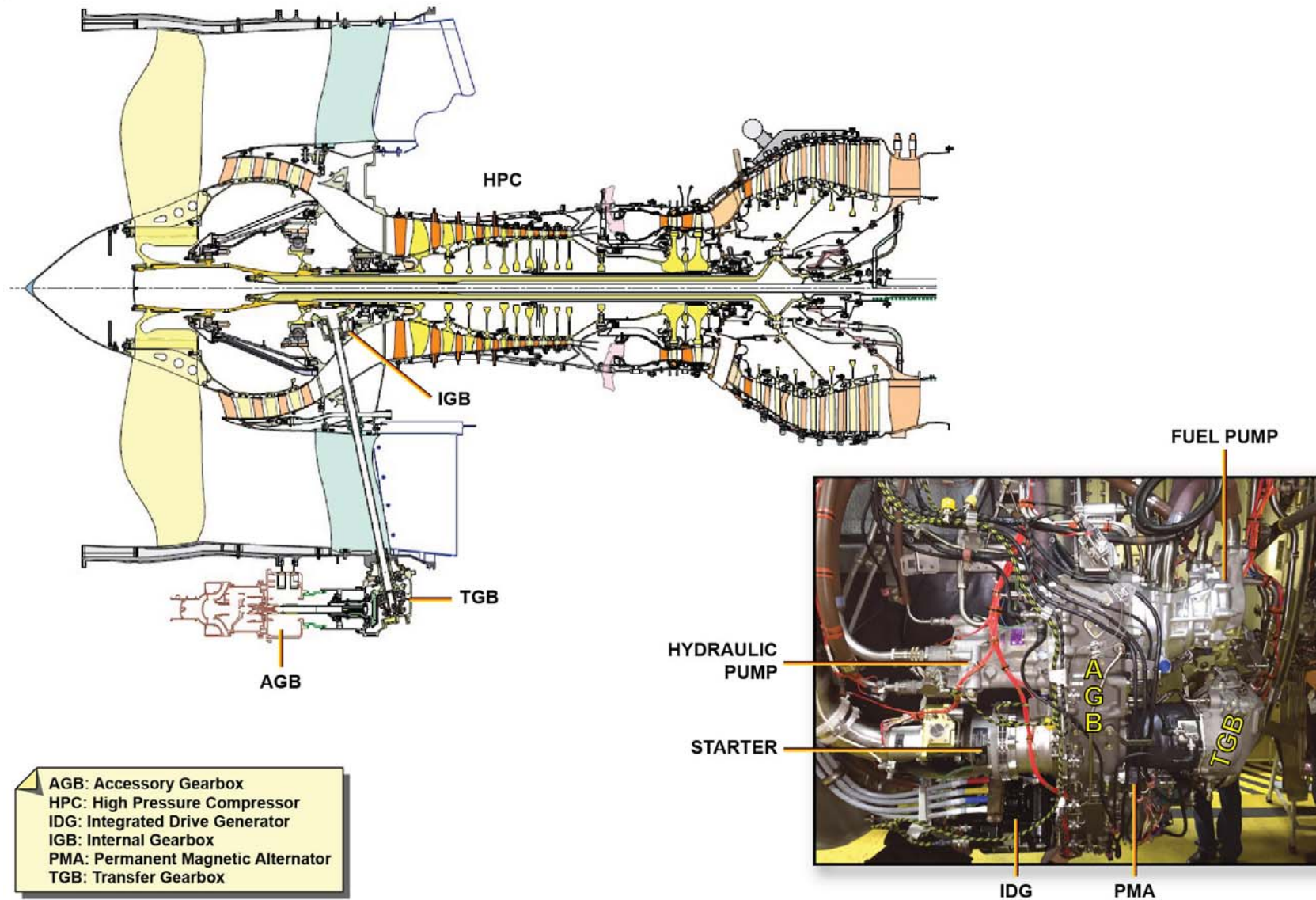
### ENGINE (continued)

#### TRANSFER & ACCESSORY GEARBOXES

During starting, the pneumatic Starter provides torque to the Internal Gearbox (IGB) through the Transfer gearbox (TGB).

When engine runs, the HPC shaft drives the Accessory Gearbox (AGB) accessories through the IGB and the TGB.

The fuel pump, lubrication unit, hydraulic pump, Integrated Drive Generator (IDG) and FADEC Permanent Magnetic Alternator (PMA) are all driven by AGB.



ENGINE - TRANSFER & ACCESSORY GEARBOXES

## POWER PLANT CFM LEAP-1A PRESENTATION

### FUEL AND STARTING

Fuel from the Aircraft tanks is pressurized, filtered, metered and supplied at the pressure and flow rate necessary to enable stable engine operations during all the phases.

The metered Fuel Flow is sent to the fuel nozzles for combustion and the Servo Fuel is supplies fuel-operated components.

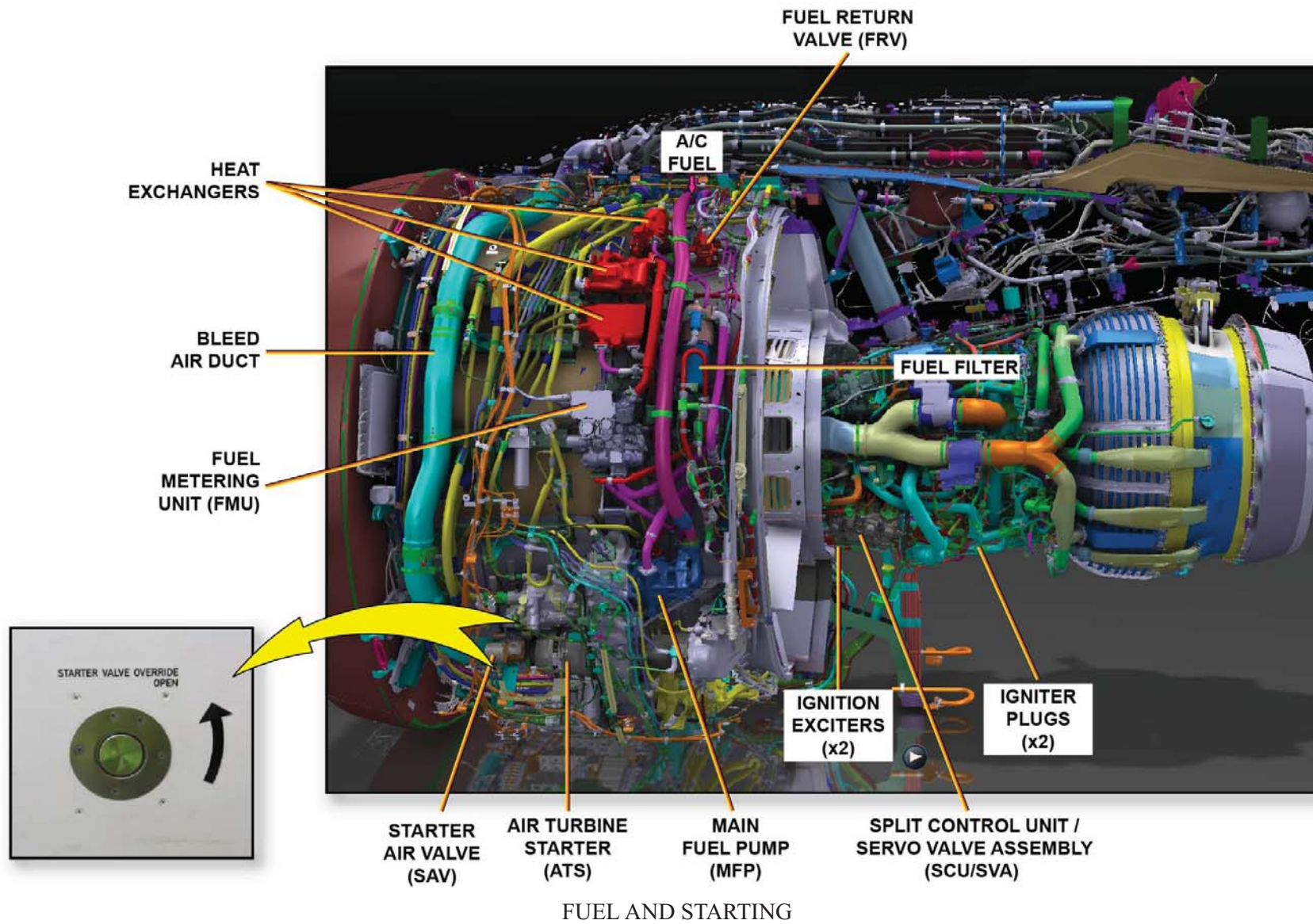
The engine fuel system comprises:

- Main Fuel Pump (MFP),
- Fuel Filter,
- Fuel/Oil Heat exchangers (FOHX),
- Fuel Metering Unit (FMU),
- Split Control Unit/Servo Valve Assembly (SCU/SVA),
- 19 Fuel nozzles,
- Fuel Return Valve (FRV).

The Aircraft Pneumatic system supplies the bleed air for Engine starting via a bleed duct on the LH side, a Starter Air Valve (SAV) and the Air Turbine Starter (ATS).

Two igniters can produce sparks within the combustion chamber to ignite the air/fuel mixture.





## POWER PLANT CFM LEAP-1A PRESENTATION

### AIR SYSTEMS

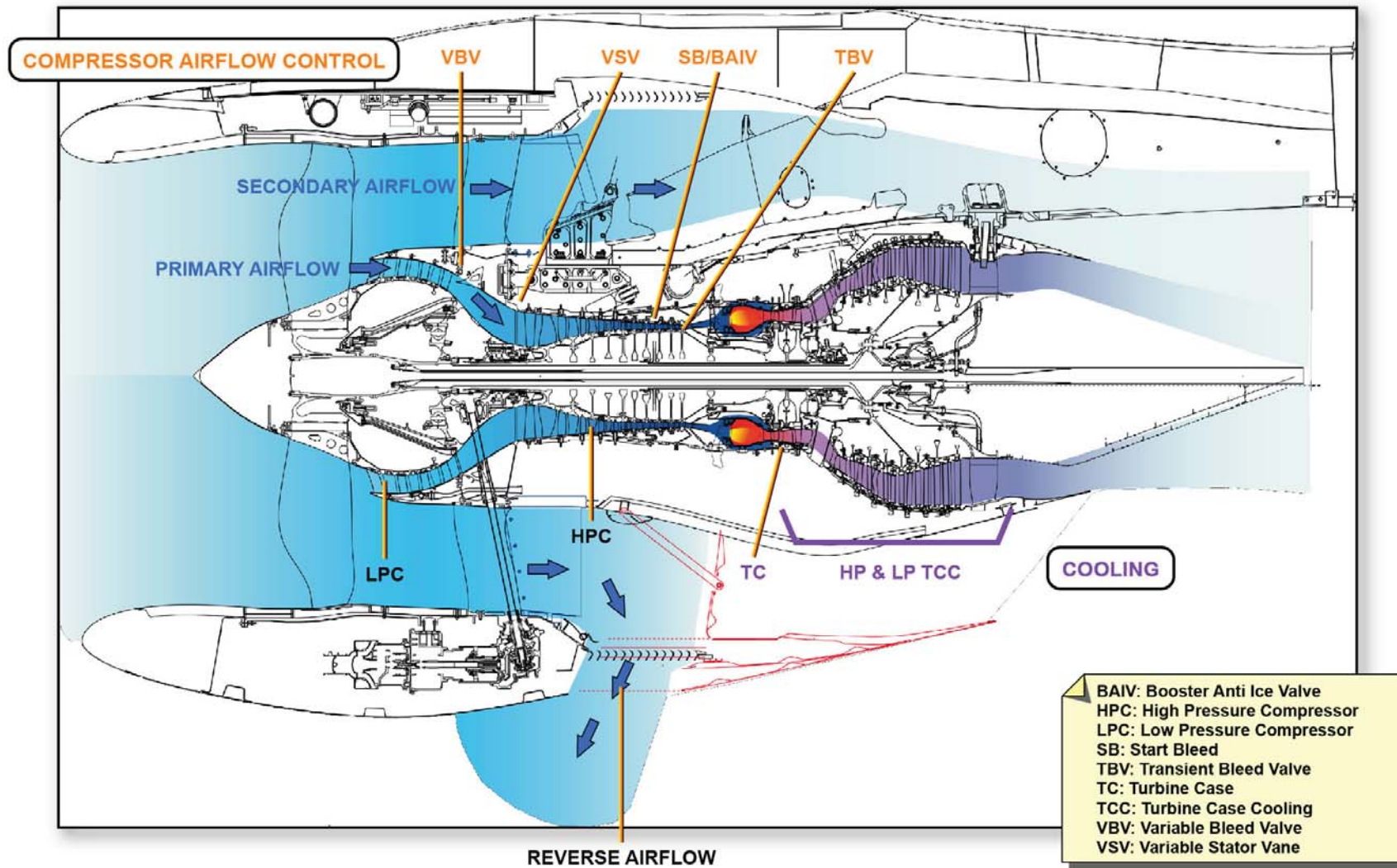
The Compressor Airflow Control is done via the following:

- Variable Bleed Valves (VBVs) modulate primary airflow,
- Variable Stator Vane (VSV) system controls the amount of airflow in HPC,
- Start Bleed/Booster Anti Ice (SB/BAI) system eases starting and avoid icing on booster inlet using 7th HPC air discharge,
- Transient Bleed Valve (TBV) system discharges part of the HPC 10th stage air to unload the compressor.

The HP Turbine blades are internally cooled.

The HP and LP Turbines' cases are externally cooled by fan air.

The Engine core compartment and accessories are ventilated.



## POWER PLANT CFM LEAP-1A PRESENTATION

### **OIL SYSTEM**

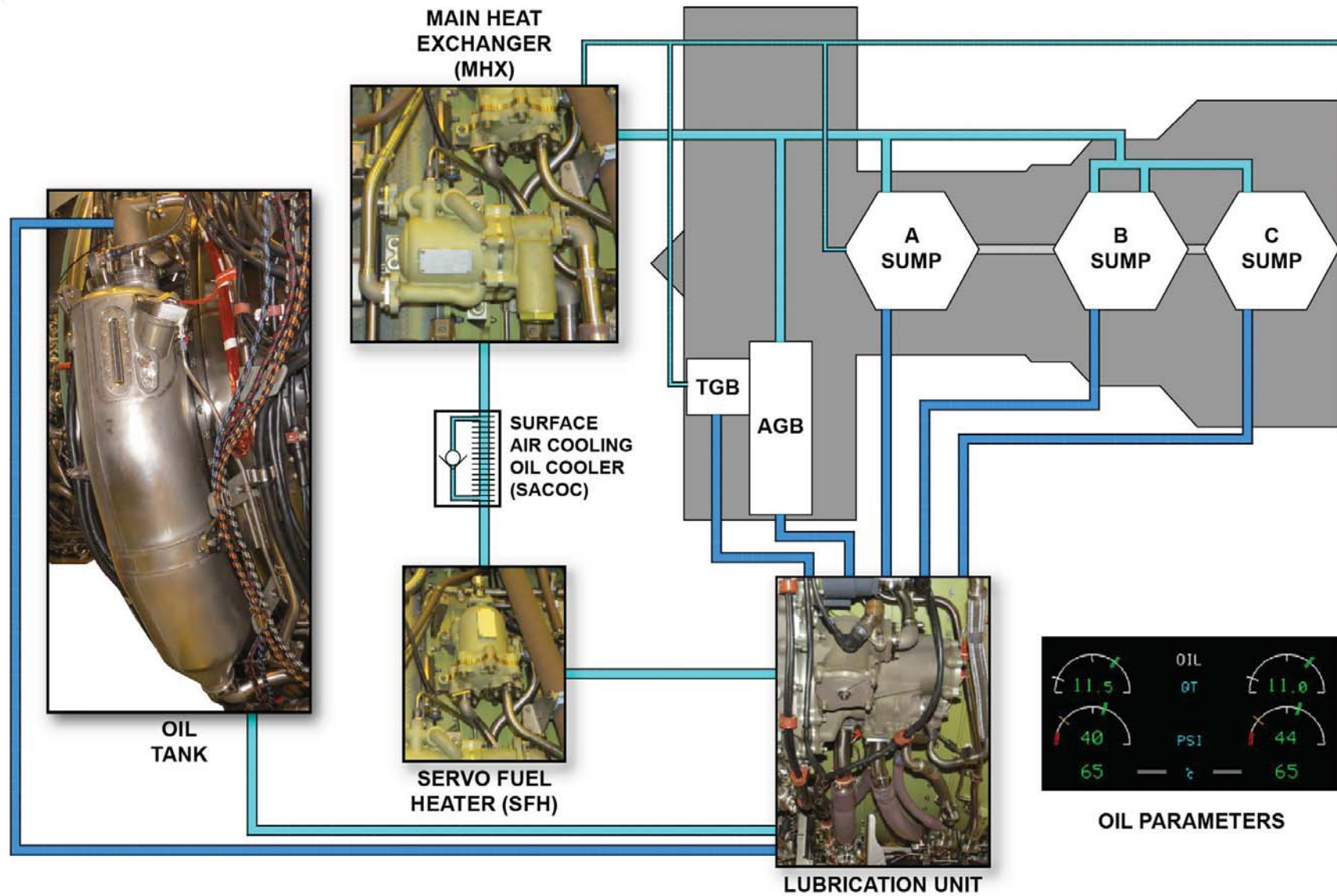
The oil system lubricates the engine bearings and gears.

The oil is supplied by the lubrication unit, cooled, filtered and scavenge back to the storage oil tank.

A vent circuit balances the internal air pressures.

The supply oil, cooled oil and the return oil parameters are monitored for ECAM warnings and indications.





OIL SYSTEM



## POWER PLANT CFM LEAP-1A PRESENTATION

### **PROPULSION CONTROL SYSTEM (PCS) - FADEC**

The Propulsion Control System (PCS) regroups the:

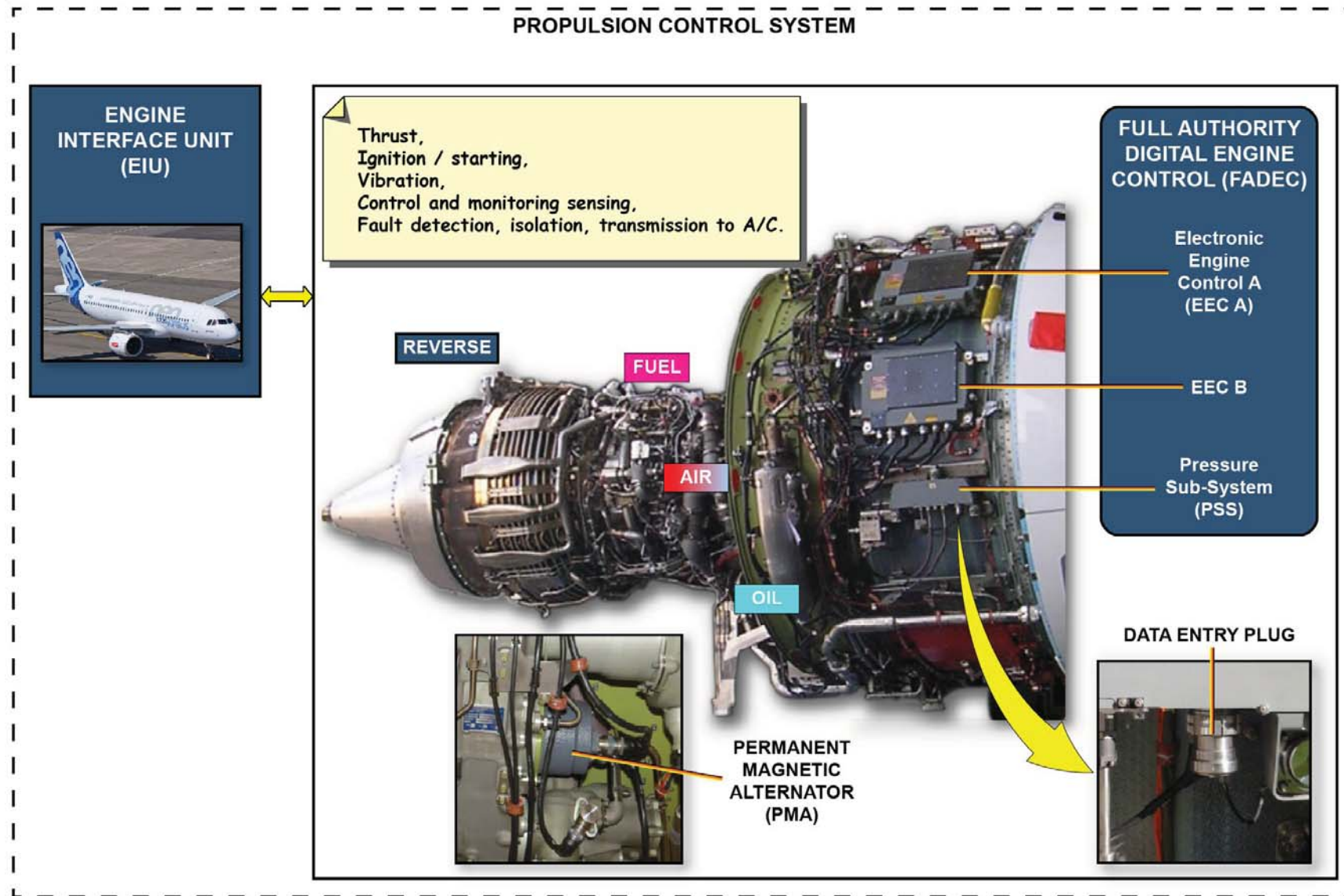
- FADEC system consists of 2 Electronic Engine Control (EEC) units and a Pressure Sub-System (PSS) box.
- Engine Interface Unit (EIU).

In order to increase engine reliability and efficiency, the FADEC gives the full range of engine control to achieve steady state and transient engine performances when operated in combination with aircraft subsystems.

The EEC controls the operation of the following:

- Engine control for thrust setting in Manual and Auto thrust Modes,
- Thrust Control Malfunction (TCM) protection,
- Engine airflow control,
- Combustor fuel metering valve,
- Control and monitoring sensing,
- Ignition and starting systems,
- Command and monitoring of the thrust reverser system,
- Fault detection, isolation, annunciation and transmission to the A/C (BITE).

When the engine is running, power for FADEC operation is supplied by a Permanent Magnet Alternator driven by the gearbox.



PROPULSION CONTROL SYSTEM (PCS) - FADEC

## POWER PLANT CFM LEAP-1A PRESENTATION

### **PROPULSION CONTROL SYSTEM (PCS) - FADEC**

**(continued)**

#### **PROPULSION CONTROL SYSTEM - EIU**

The EIU is an interface concentrator between the airframe and the corresponding engine. Two EIUs are installed in the A/C.

EIU-1 interfaces with Engine 1 and EIU-2 interfaces with Engine 2.

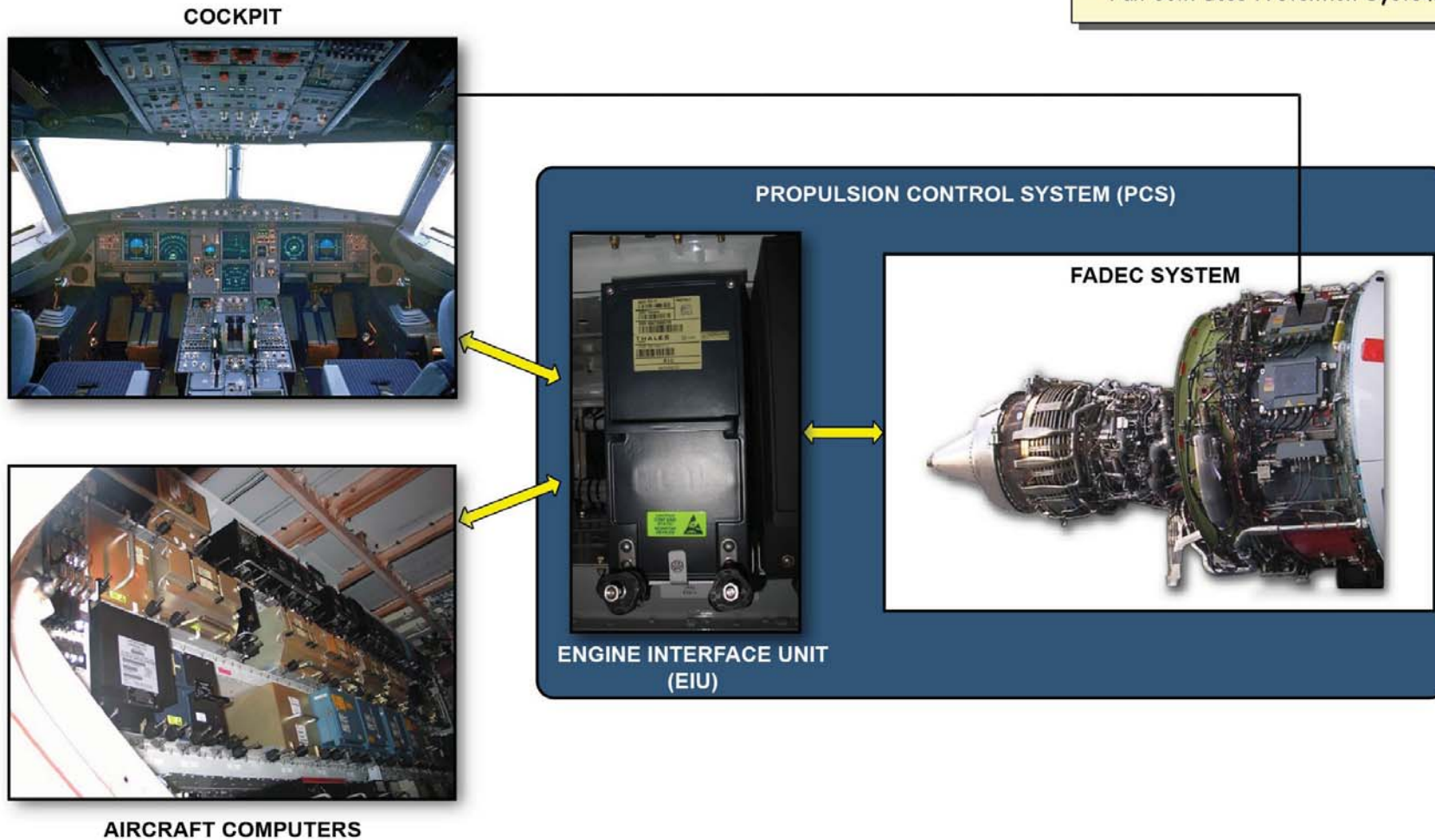
The main functions of the EIU are:

- To concentrate data from cockpit panels and different aircraft systems to the associated EECs on each engine,
- To ensure the segregation of the two engines,
- To give to the airframe the necessary logic and information from engine and to other systems (APU, ECS, Bleed Air, Maintenance),
- To give to the FADEC system some necessary logic and information from systems (example: flight/ground status).

The Fan Cowl latches of the A320 NEO are monitored by proximity switches which send their position signals to the EIU.

The EIU transfers signals to the Flight Warning Computer (FWC) for associated cockpit warnings based on specific logic conditions.

Fan Cowl Loss Prevention System



PROPULSION CONTROL SYSTEM (PCS) - FADEC - PROPULSION CONTROL SYSTEM - EIU

## POWER PLANT CFM LEAP-1A PRESENTATION

### **THRUST REVERSER SYSTEM**

The flight crew manually selects reverse thrust by lifting the latching levers on the throttle control levers on ground only.

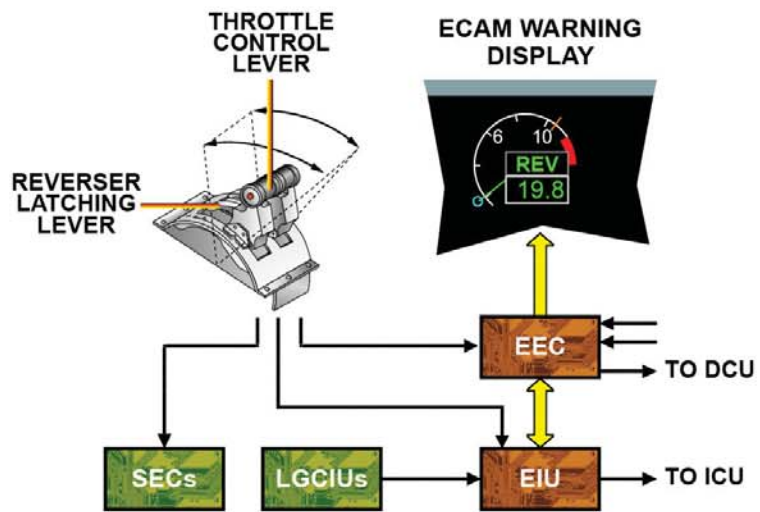
The thrust reverser system operates 2 synchronized and mechanically linked translating sleeves, 10 blocker doors with cascade vanes per engine. Isolation Control Unit (ICU) supplies hydraulic power to operate thrust reverser actuators.

The EEC in accordance with the EIU control the ICU and Directional Control Unit (DCU) for deploy and stow sequences with 4 actuators.

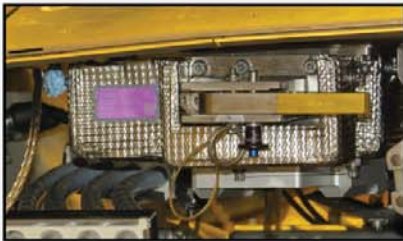
The Spoiler Elevator Computers (SECs) authorize unlocking of Electrical Tertiary Locks (ETLs).

For maintenance or dispatch the reverser system can be inhibited.

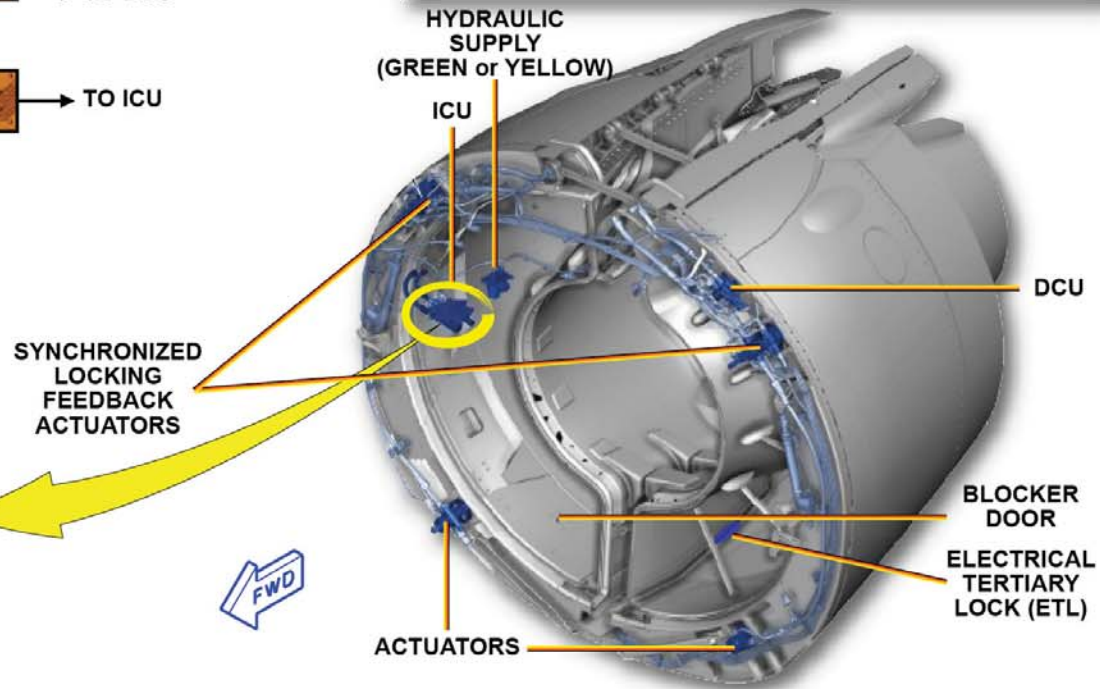




DCU: Directional Control Unit  
EEC: Electronic Engine Control  
EIU: Engine Interface Unit  
ETL: Electrical Tertiary Lock  
ICU: Isolation Control Unit  
LGCIU: Landing Gear Control Interface Unit  
SEC: Spoiler Elevator Computer



ICU ACTIVE



THRUST REVERSER SYSTEM

## POWER PLANT CFM LEAP-1A PRESENTATION

### CONTROL AND INDICATING

This section will highlight the control panels and indications for the engines.

#### CONTROL PANELS

The engines are controlled by throttle control levers which are installed on the center pedestal. They can only be moved manually.

For reverse thrust operation, two latching levers let the throttle control levers move rearward into the reverse thrust section.

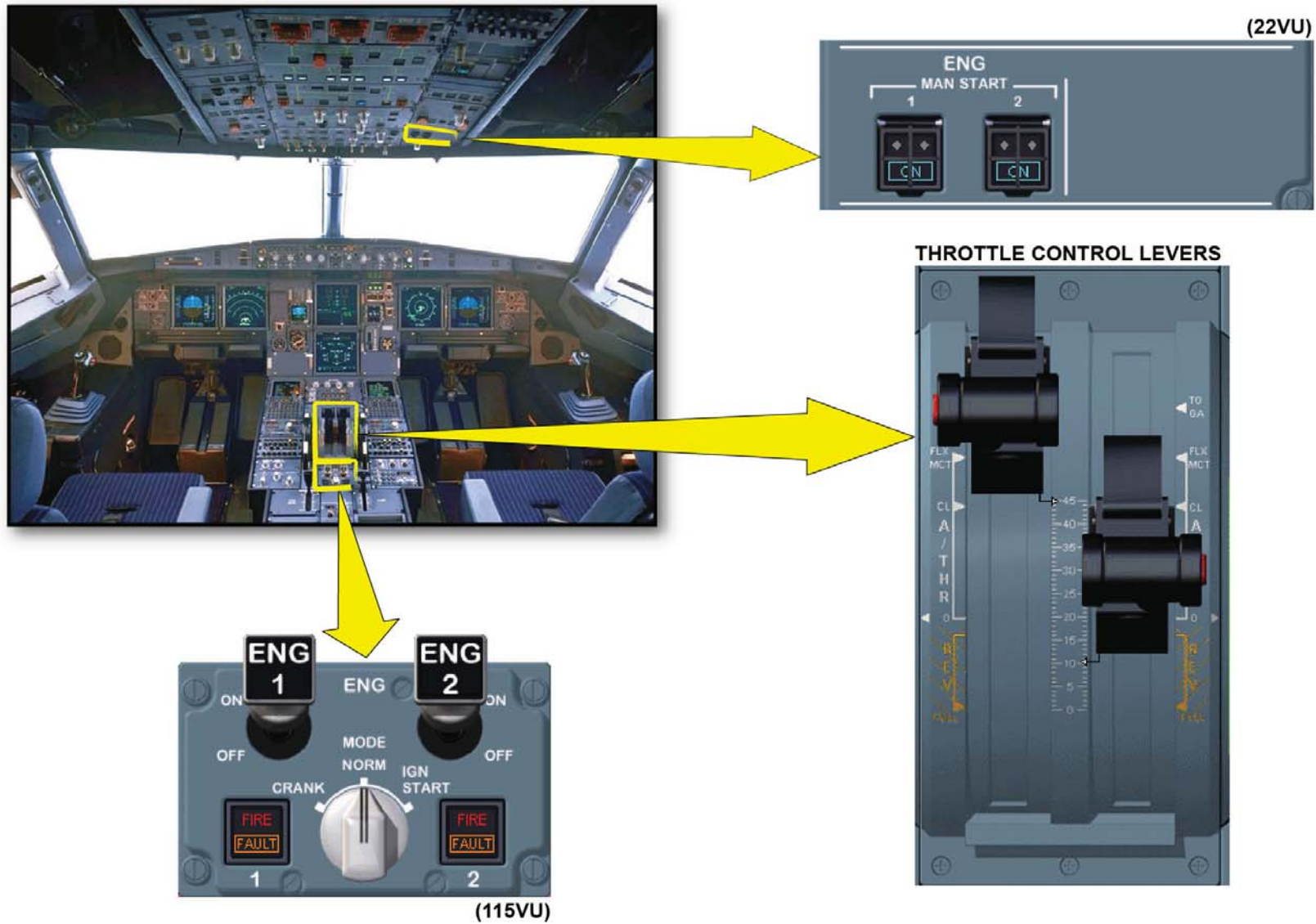
The A320 family aircraft normally operate in the auto thrust mode, when in flight.

The autothrust can be disconnected with an instinctive disconnect pushbutton (2 red buttons are installed on the outside of the lever).

This lets the engines be controlled in manual thrust mode.

The controls for engine starting and shutdown are installed on the center pedestal immediately below the throttle control levers.

The engine MAN START switches are installed on the overhead panel. These switches are used to start an engine during a manual start procedure. They are also used during a dry or wet motoring procedure.



CONTROL AND INDICATING - CONTROL PANELS

## POWER PLANT CFM LEAP-1A PRESENTATION

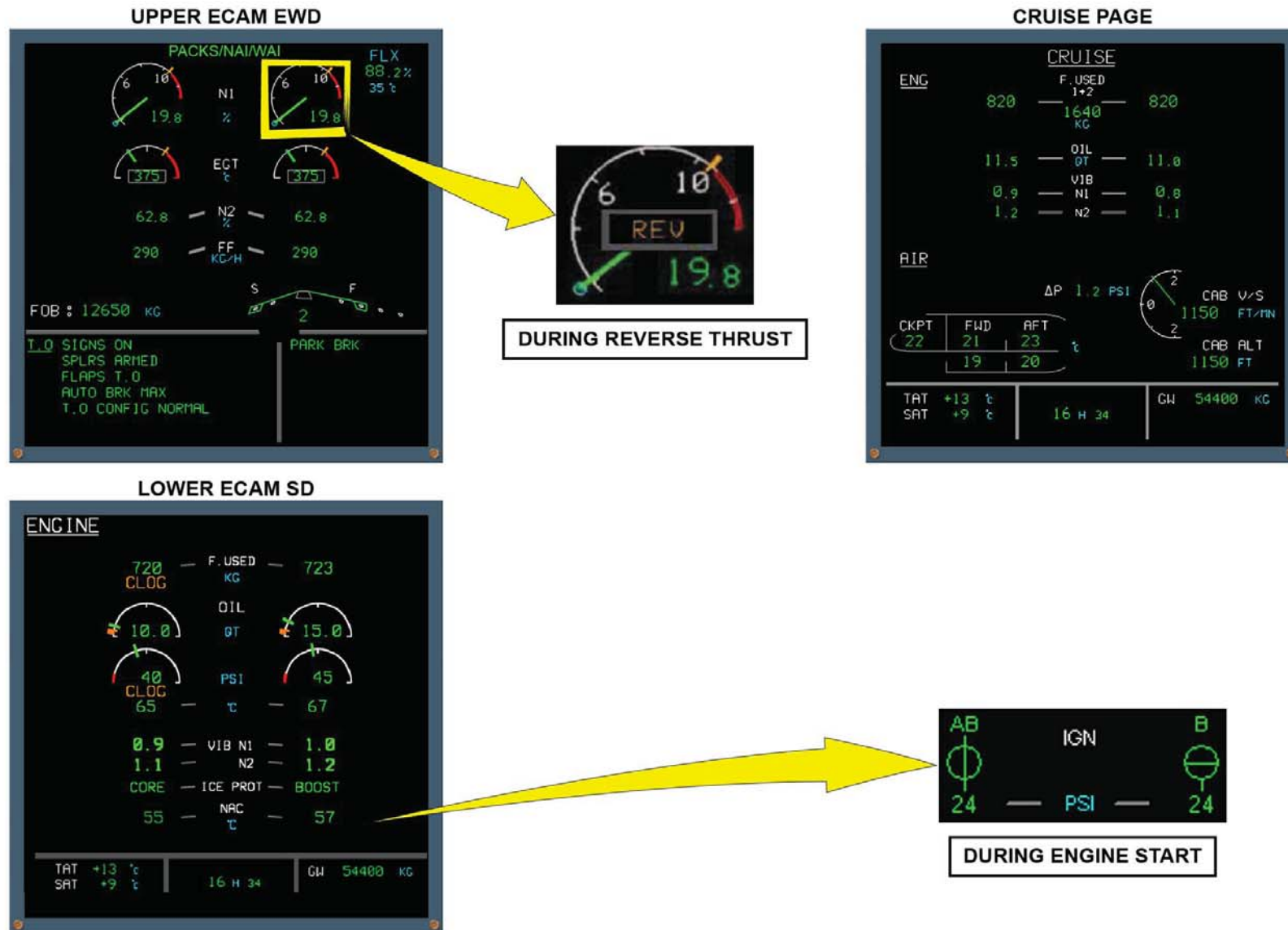
### CONTROL AND INDICATING (continued)

#### ECAM ENGINE

The engine primary parameters are permanently displayed on the upper ECAM.

The engine secondary parameters are presented on the lower ECAM ENGINE page when selected or displayed automatically during engine start or a fault.

Some engine parameters are permanently displayed on the CRUISE page in flight.



CONTROL AND INDICATING - ECAM ENGINE

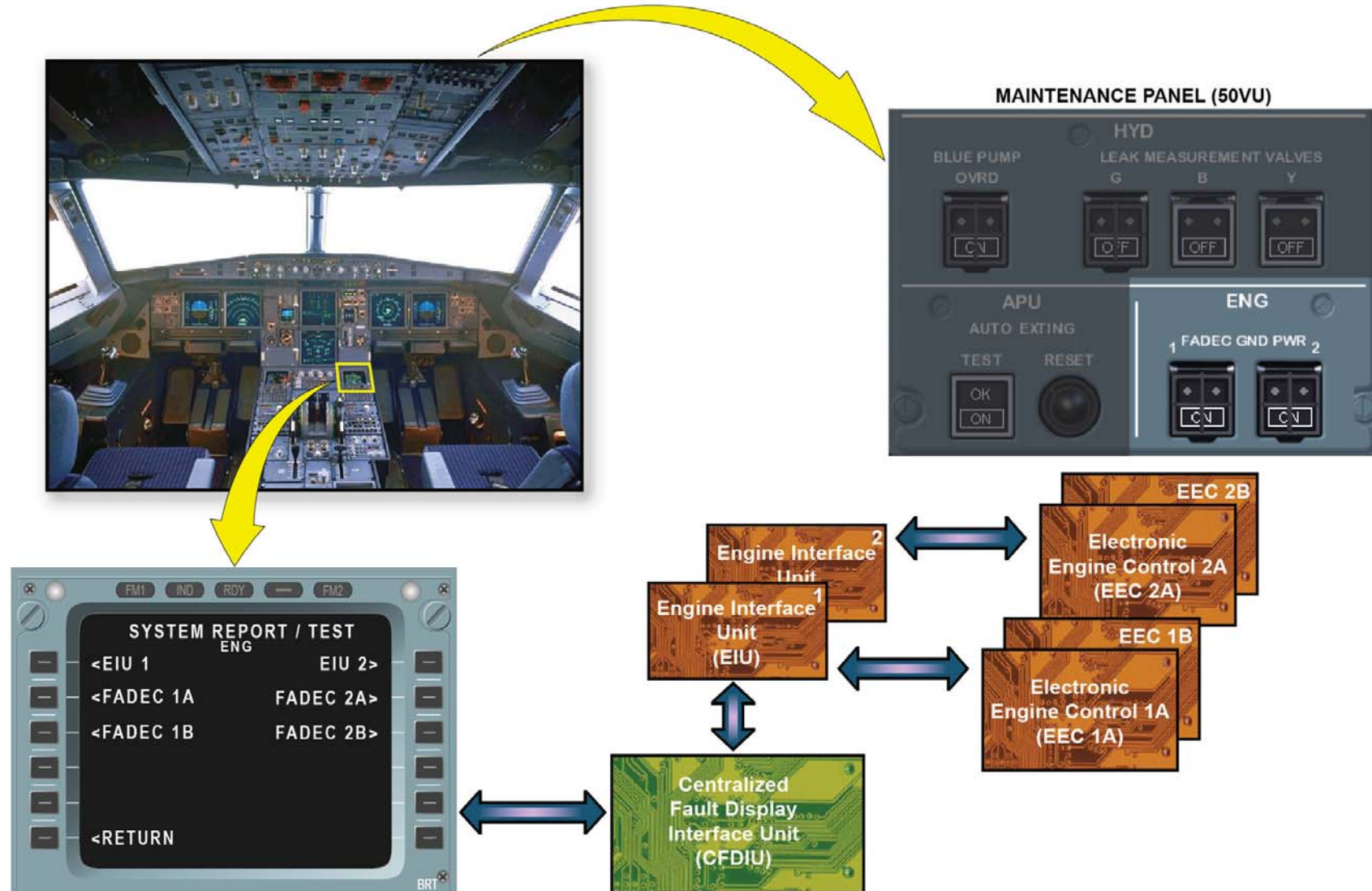


## POWER PLANT CFM LEAP-1A PRESENTATION

### **MAINTENANCE/TEST FACILITIES**

On the maintenance panel, the ENG FADEC GND PWR permits to supply the FADEC system for maintenance tasks, when the engines are not running.

The Multipurpose Control and Display Unit (MCDU) is used to do PCS tests and for trouble shooting monitored components (computers, sensors, actuators).



MAINTENANCE/TEST FACILITIES

## POWER PLANT CFM LEAP-1A PRESENTATION

### SAFETY PRECAUTIONS

When you work on aircraft, make sure that you obey all the Aircraft Maintenance Manual (AMM) safety procedures.

This will prevent injury to persons and/or damage to the aircraft. Here is an overview of main safety precautions related to the engines.

Make sure that all engine danger areas are as clear as possible to prevent damage to the engine, the aircraft or persons in the area.

Be careful: The entry corridor will be closed when the engine power is above the minimum.

Make sure that you have fire-fighting equipment available.

Do not try to stop the fan from turning by hand.

After engine shutdown, let the oil tank pressure bleed off for a minimum of 5 minutes before you remove the tank filler cap. If you do not, pressurized oil can flow out of the tank and cause dangerous burns.

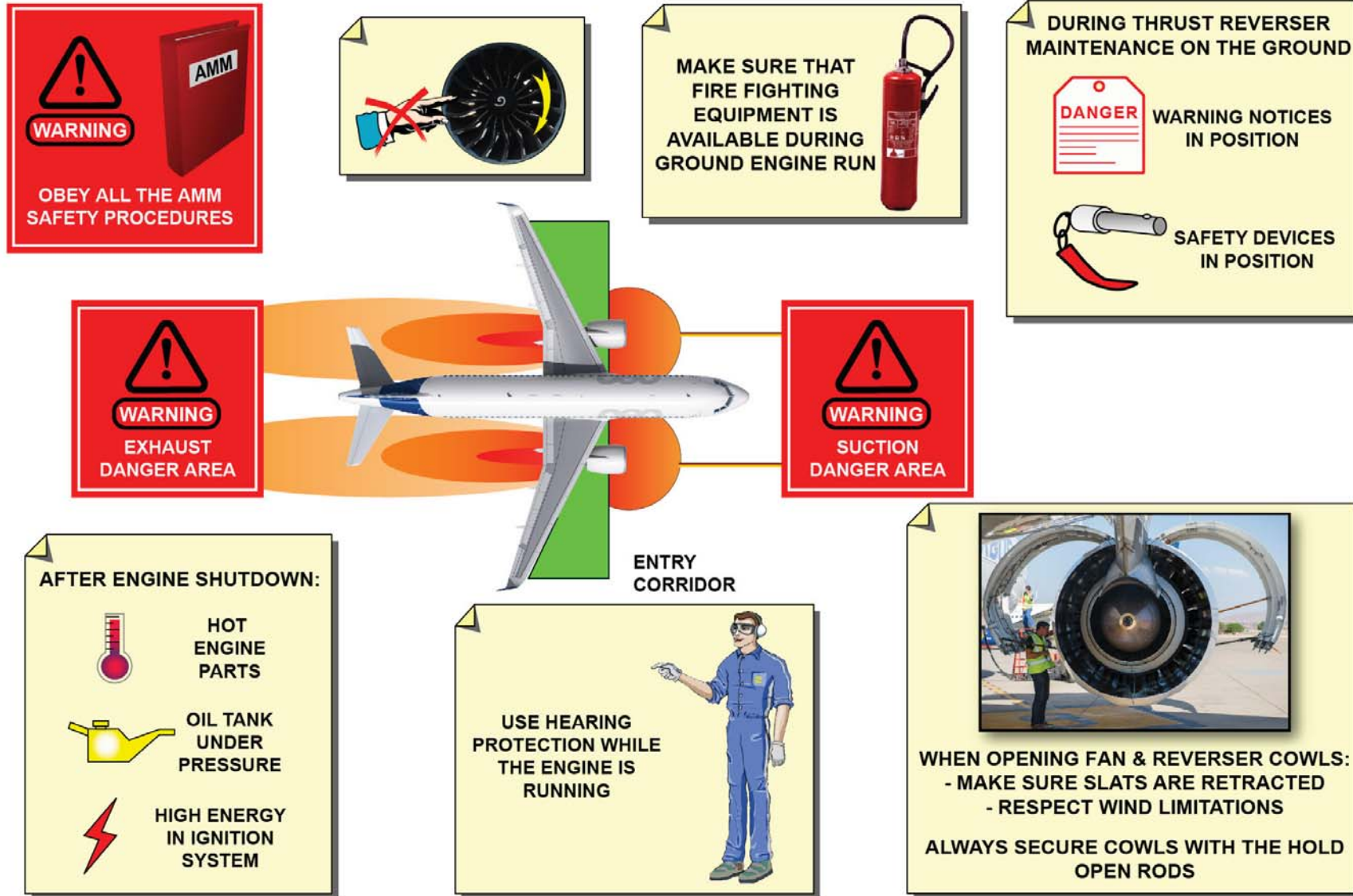
The engine ignition system is an electrical system with high energy. You must be careful to prevent electrical shock. Injury or death can occur. Do not do maintenance on the ignition system while the engine operates.

Make sure that the engine shutdown occurred more than 5 minutes ago before you continue with the maintenance procedure.

Make sure that the thrust reverser is deactivated during maintenance. If not, the thrust reverser can operate accidentally and cause injury to personnel and/or damage to the reverser.

When opening the engine cowl:

- Respect the wind limitations and the opening/closing sequence,
- Always secure cowls with the hold-open rods,
- Make sure that the slats are retracted and install a warning notice to prevent slat operation.



SAFETY PRECAUTIONS

## POWER PLANT CFM LEAP-1A PRESENTATION

### **STORAGE AND PRESERVATION**

Storage and preservation procedures must be applied to engines which are not operated. The preservation procedures protect the engine against corrosion, liquid and debris entering the engine, and atmospheric conditions during period of inactivity.





**STORAGE AND PRESERVATION PROCEDURES MUST BE APPLIED FOR ENGINES WHICH ARE NOT OPERATED.**

**PROTECTION AGAINST  
ATMOSPHERIC CONDITIONS**



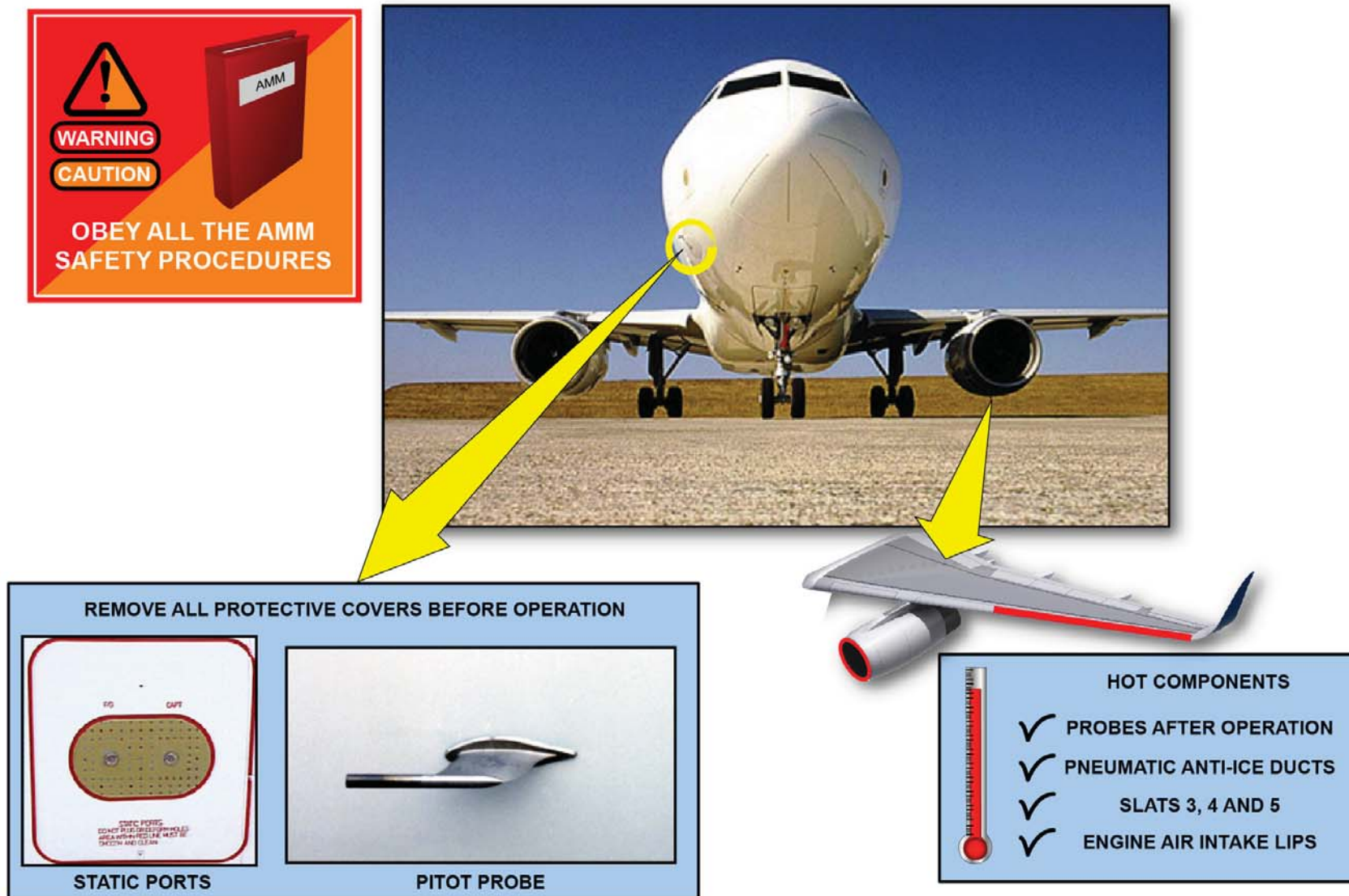
**THE PRESERVATION PROCEDURES PROTECT THE ENGINE AGAINST CORROSION, LIQUID AND DEBRIS ENTERING THE ENGINE, AND ATMOSPHERIC CONDITIONS DURING PERIOD OF INACTIVITY.**



**UNDER NO CIRCUMSTANCES SHALL PRESERVATIVE OIL OR EQUIVALENT BE SPRAYED INTO THE ENGINE INLET, CORE COMPRESSOR OR TURBINE, OR ENGINE EXHAUST. DIRT PARTICLES DEPOSITED ON THE WET BLADES AND VANES MAY ADVERSELY AFFECT ENGINE PERFORMANCE DURING SUBSEQUENT OPERATION.**

## STORAGE AND PRESERVATION

THIS PAGE INTENTIONALLY LEFT BLANK



SAFETY PRECAUTIONS

## 30 ICE AND RAIN PROT SYSTEMS PRESENTATION

### **SAFETY PRECAUTIONS (continued)**

#### **WARNINGS ABOUT FAIL SAFE HEATING**

The probe heat system is a fail-safe system used to keep the probes and static ports de-iced (in flight) if a PHC failure occurs.

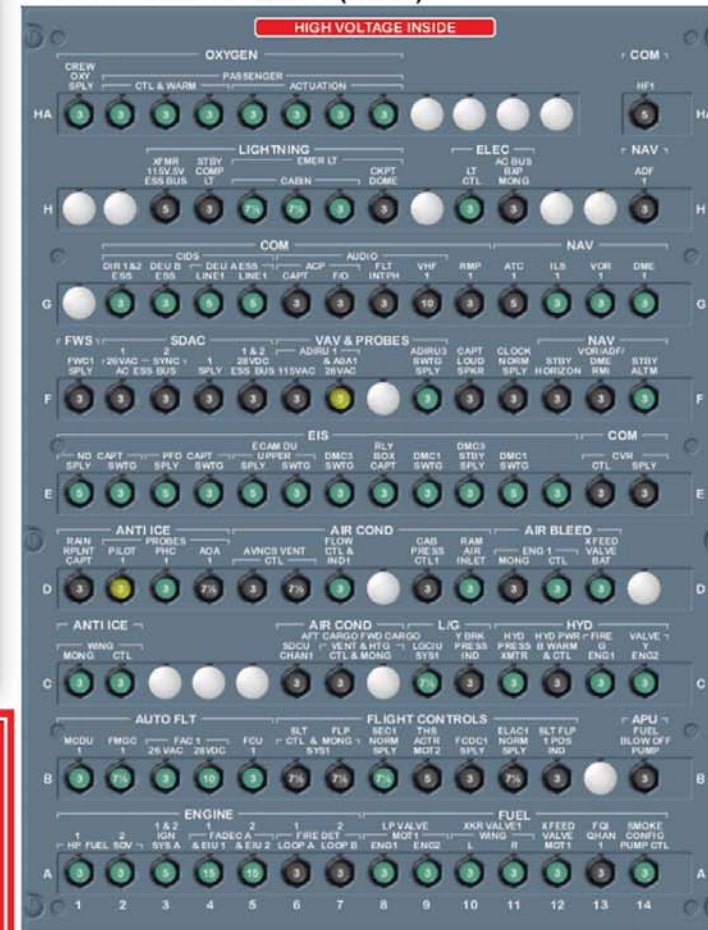
The window heat system is designed to keep the windows defogged (in flight) if a WHC failure occurs.

If the PHC or WHC power Circuit Breakers (C/Bs) are pulled, the probe or window heat will come on. This will also occur if the EIU C/B is pulled. The EIU controls the "engine running" signal for automatic operation. If one of these C/Bs is pulled, all of the heater C/Bs must also be pulled.





OVERHEAD C/B PANEL (49VU)



**WARNING**

**PULLING THE PROBE HEAT COMPUTER (PHC), THE LANDING GEAR CONTROL AND INTERFACE UNIT (LGCIU) OR THE ENGINE INTERFACE UNIT (EIU) POWER SUPPLY CIRCUIT BREAKERS CAUSES UNWANTED HEATING OF THE PROBES & STATIC PORTS AND / OR THE WINDOWS. THIS CAN CAUSE INJURY AND BURNS.**

SAFETY PRECAUTIONS - WARNINGS ABOUT FAIL SAFE HEATING